I CLAIM:

1. A hot runner system for injecting plastics material from a plasticizer unit into an injection mold for molding very small plastic devices and parts, said system comprising:

a hot runner manifold having an inlet for receiving melted plastics material from said plasticizer unit, at least one heating arrangement for maintaining the manifold at a selected elevated temperature suitable for flow of said melted plastics material through said manifold without undesirable degradation, an elongate plastics feed conduit connected to said inlet, a check valve mounted in said manifold and allowing one-way flow of said plastics material in said feed conduit in a direction of flow away from said inlet;

at least one injection apparatus operatively connected to a downstream end of said feed conduit, the or each injection apparatus having a central longitudinal injection axis;

a metering apparatus adapted to provide a precise quantity of said melted plastics material to said at least one injection apparatus, said metering apparatus including a cylinder unit forming an elongate metering chamber and a ram movable in said metering chamber, said metering chamber having a longitudinal axis and an inner end which is open at one side of an elongate portion of said feed conduit and which is downstream of said check valve, said longitudinal axis being substantially perpendicular to a central longitudinal axis of said elongate portion, and a controller for controlling movement of said ram in said metering chamber, said at least one injection apparatus being spaced a substantial distance from said metering apparatus including said inner end of the metering chamber,

wherein said metering apparatus is able to provide a selected quantity of said melted plastics material to said at least one injection apparatus via a downstream section of said feed conduit while said check valve prevents melted plastics material in said feed conduit from backflowing to said plasticizer unit, said at least one injection apparatus is adapted to inject said selected quantity of said melted plastics material into at least one molding

cavity of said injection mold, and the central longitudinal injection axis of said at least one injection apparatus is at a substantial angle to said longitudinal axis of the elongate chamber.

2. A hot runner system according to claim 1 wherein said check valve includes a valve chamber and a ball movable within said chamber between a valve closing position at an upstream side of the valve chamber and a valve open position at a downstream side of said chamber.

3. A hot runner system according to claim 2 wherein said check valve includes a valve body which is a valve member separate from said manifold and in which said valve chamber is at least partially formed, and grooves are formed in said valve body in said downstream side of said chamber, said grooves permitting flow of said melted plastics material around and past said ball.

4. A hot runner system according to claim 1 wherein said metering apparatus includes a piston member rigidly connected to an outer end of the ram and substantially wider than said ram, a piston housing forming a piston chamber in which said piston member is slidingly movable, and a pressurizing system for providing pressurized fluid to said piston chamber in order to drive both said piston member and said ram inwardly until an inner end of said ram reaches said inner end of said metering chamber and thereby provide said selected quantity of melted plastics material.

5. A hot runner system according to claim 4 including a threaded adjusting bolt having a central longitudinal axis aligned with said longitudinal axis of said metering chamber and plate means for supporting said adjusting bolt so that the latter extends outwardly from an outer end of said piston member, wherein an outermost limit to outward movement of said piston member and ram can be set by turning said bolt inwardly or outwardly about its central longitudinal axis.

6. A hot runner system according to claim 1 wherein said hot runner manifold includes first and second manifold sections which are separated by an insulating gap, said first manifold section being maintained at a substantially lower temperature range than said second manifold section during operation of said hot runner system whereby said melted plastics material can reside in a substantial portion of said feed conduit which is within said first manifold section for an extended length of time without significant degradation.

7. A hot runner system according to claim 6 wherein said check valve is mounted between said first and second manifold sections and at least an inner section of said metering chamber is located within said second manifold section.

8. A hot runner system according to claim 1 wherein said plastics feed conduit has a diameter that can vary and is in the range of 1 to 5 mm.

9. A hot runner system according to claim 8 wherein there are two of said at least one injection apparatus and said elongate portion of said feed conduit splits into two branch bores downstream of said inner end of the metering chamber, said two branch bores extending respectively to the two injection apparatuses, whereby during use of the hot runner system, said metering apparatus is able to provide one half of said selected quantity of the melted plastics material to each injection apparatus.

10. A hot runner system according to claim 8 wherein said ram and said metering chamber each have a diameter in the range of 2 to 4 mm and the central longitudinal axis of said at least one injection apparatus is substantially perpendicular to said longitudinal axis of the elongate chamber.

11. A hot runner system for injecting hot, melted plastics material from a plasticizer unit into at least one small mold cavity, said system comprising:

a hot runner manifold having an inlet for receiving said melted plastics material from said plasticizer unit, a heating arrangement for maintaining said manifold in one or more desired temperature ranges suitable for conducting said melted plastics material through said manifold, and at least one elongate plastics feed conduit formed in said manifold and connected to said inlet;

a check valve mounted in said manifold and constructed to allow only one way flow of said plastics material in said at least one feed conduit in a direction of flow away from said inlet, said check valve including a valve chamber and a valve member movable within said chamber by the melted plastics material between a valve closing position at an upstream side of said chamber and a valve open position at a downstream side of said chamber;

at least one plastics injection apparatus operatively connected to an outlet end of said at least one feed conduit and adapted to inject a selected quantity of said melted plastics material into said at least one small mold cavity;

a metering apparatus capable of providing a selected small quantity of said melted plastics material to said at least one injection apparatus while said at least one injection apparatus is carrying out its plastic injection operation, said metering apparatus including an elongate metering chamber and a ram movable in said metering chamber, said metering chamber having an open inner end located on one side of one of said at least one feed conduit downstream of said check valve and upstream of said outlet end of said at least one feed conduit,

wherein said metering apparatus is able to provide said selected small quantity of said melted plastics material to said at least one injection apparatus via a downstream section of said at least one feed conduit while said check valve prevents said melted plastics material from backflowing to said plasticizing unit.

12. A hot runner system according to claim 11 wherein said check valve includes a valve body, which is a body separate from but attached to said manifold and in which said valve chamber is at least partially formed, said valve member is a metal ball, and grooves are formed in said valve body at

said downstream side of said chamber, said grooves permitting flow of said melted plastics material around and past said metal ball during use of said hot runner system.

13. A hot runner system according to claim 11 wherein said metering apparatus includes a piston member rigidly connected to an outer end of the ram and substantially wider than said ram, a piston housing forming a piston chamber in which said piston member is slidingly movable, and a pressurizing system for providing pressurized fluid to said piston chamber in order to drive both said piston member and said ram inwardly until an inner end of said ram reaches said inner end of said metering chamber and thereby provide said selected quantity of melted plastics material.

14. A hot runner system according to claim 13 including a threaded adjusting bolt having a central longitudinal axis aligned with said longitudinal axis of said metering chamber and plate means for supporting said adjusting bolt so that the latter extends outwardly from an outer end of said piston member, wherein an outermost limit to outward movement of said piston member and ram can be set by turning said bolt inwardly or outwardly about its central longitudinal axis.

15. A hot runner system according to claim 11 wherein said hot runner manifold includes first and second manifold sections which are separated by an insulating gap, said first manifold section being maintained at a substantially lower temperature range than said second manifold section during operation of said hot runner system whereby said melted plastics material can reside in a substantial portion of said at least one feed conduit which is within said first manifold section for an extended period of time without significant degradation.

16. A hot runner system according to claim 15 wherein said check valve is mounted between said first and second manifold sections and at least an inner section of said metering chamber is located within said second manifold section.

17. A hot runner system according to claim 11 wherein said at least one feed conduit has a diameter that varies in the range of 1 to 5 mm and said valve member is a metal ball.

18. A hot runner system according to claim 12 wherein there are two of said at least one injection apparatus and said one feed conduit splits into two branch bores downstream of said inner end of the metering chamber, said two branch bores extending respectively to the two injection apparatuses, whereby during use of the hot runner system, said metering apparatus is able to provide one half of said selected quantity of the melted plastics material to each injection apparatus.

19. A hot runner system for injecting melted plastics material from a plasticizer unit into at least one mold cavity, said system comprising:

a two-part manifold apparatus including first and second manifold sections which are located close to each other but are spaced apart a short distance by an insulating arrangement, said first manifold section including an inlet for receiving melted plastics material from said plasticizer unit, a first feed conduit system formed in said first manifold section for conducting said melted plastics material to said second manifold section, said first feed conduit system being connected to said inlet, and a second feed conduit system formed in said second manifold section for conducting said melted plastics material, said second feed conduit system being operatively connected to said first feed conduit system;

at least one primary heater for heating said first manifold section to a first elevated temperature range suitable for conducting said melted plastics material without significant thermal degradation;

at least one secondary heater for heating said second manifold section to a second temperature range which is hotter than said first temperature range and which heats the melted plastics material to the second temperature range which is suitable for injecting the melted plastics material into said at least one mold cavity;

at least one injection apparatus for respectively injecting a desired quantity of the melted plastics material into said at least one mold cavity, said at least one injection apparatus being operatively connected to said second feed conduit system;

at least one check valve mounted in said manifold apparatus to provide one-way flow of the melted plastics material in a direction away from said inlet; and

metering apparatus for providing said desired quantity of the melted plastics material to each of said at least one mold cavity, said metering apparatus being provided in said second manifold section so as to deliver said desired quantity of the melted plastics material to said second conduit system at at least one location downstream from said at least one check valve.

20. A hot runner system according to claim 19 wherein said insulating arrangement is an air gap formed between said first and second manifold sections and each of said at least one primary heater and said at least one secondary heater is a tubular electrical heater mounted in or to its respective manifold section.

21. A hot runner system according to claim 19 wherein each of said at least one check valve includes a valve chamber and a ball movable within said chamber between a valve closing position at an upstream side of the valve chamber and a valve open position at a downstream side of said valve chamber.

22. A hot runner system according to claim 21 wherein said at least one check valve includes at least one valve body in which said valve chamber is at least partially formed and said at least one valve body is mounted between said first and second manifold sections, and wherein grooves are formed in said at least one valve body in said downstream side of said chamber, said grooves permitting flow of said melted plastics material around and past said ball during use of the hot runner system.

23. A hot runner system according to claim 19 wherein said insulating arrangement is an air gap formed between said first and second manifold sections and said at least one check valve includes at least one valve body which is mounted between said first and second manifold sections and extends across said air gap.

24. A hot runner system according to claim 23 wherein each of said at least one check valve includes a valve chamber and a ball movable within said chamber between a valve closing position at an upstream side of the valve chamber and a valve open position at a downstream side of said valve chamber.

25. A hot runner system according to claim 24 wherein each valve chamber has an upstream section formed in a side of said first manifold section and a remaining section formed in one of said at least one valve body.

26. A hot runner system according to claim 19 wherein said first feed conduit system includes a main feed bore connected to said inlet and extending lengthwise of said first manifold section and a plurality of branch bores each extending from said main feed bore to a side of said first manifold section facing said second manifold section, and wherein said second feed conduit system comprises a plurality of separate connecting bores each operatively connected to a respective one of said branch bores.

27. A hot runner system according to claim 19 wherein said metering apparatus includes at least one metering unit comprising an elongate metering chamber having a longitudinal axis and a ram movable in said metering chamber, said metering chamber having an inner end which is open at one side of an elongate section of said second conduit system and which is downstream of a respective one of said at least one check valve.

28. A hot runner system according to claim 19 including a plurality of injection apparatuses each adapted to inject said desired quantity of the melted plastics material into a single mold cavity.

29. A hot runner system according to claim 28 capable of injecting said melted plastics material into a plurality of very small mold cavities, wherein each of said first and second feed conduit systems has a conduit diameter in the range of 1 to 5 mm.

30. A hot runner system according to claim 29 wherein said insulating arrangement is an air gap formed between said first and second manifold sections and each of said at least one primary heater and said at least one secondary heater is a tubular electrical heater mounted in its respective manifold section.